

Module 8 - Personal Protective Equipment (PPE)

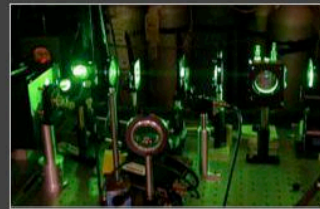
PDF Version

NOTE: It is recommended that you view the
interactive online version for the best
explanation of the laser-safety concepts.

Personal Protective Equipment (PPE)

After completing this module, you will be able to:

- recognize the different types of laser PPE.
- describe how laser eyewear works.
- recognize the vital elements in selecting laser eyewear.
- identify common problems associated with laser eyewear.
- store your laser safety eyewear properly.
- match eyewear labels to warning signs.



Audio Narration (slide 1)

PPE is the third level of control against laser hazards. You are the limiting factor with PPE. If you chose not to wear the appropriate laser protection you will not be protected.

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- Describe how laser eyewear works.
- Recognize the vital elements in selecting laser eyewear.
- Identify common problems associated with laser eyewear.
- Store your laser safety eyewear properly.
- Match eyewear labels to warning signs.

Protective Clothing

- worn for UV exposure hazards.
- wear when required by the safety documentation or your supervisor.



Audio Narration (slide 2)

Laser eyewear is not the only type of laser PPE. When clothing is worn as PPE, it usually means there are UV exposure hazards. Such exposures can lead to both acute and chronic health effects such as skin burns or skin cancer. Wear protective clothing when required by the safety documentation or your supervisor. Working with ultraviolet wavelengths may also require gloves and a lab coat, for example.

Types of Laser Safety Eyewear

Alignment eyewear:

- applies to only visible wavelengths.
- provides less than full protection.
- will NOT stop a full-power direct beam.

Full protection eyewear - reduce exposure to a level safely below Maximum Permissible Exposure (MPE).



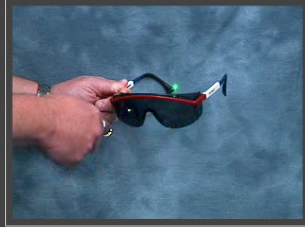
Audio Narration (slide 3)

Alignment eyewear only applies to visible wavelengths and is designed to provide a level of protection less than full protection. This type of eyewear will let you see the beam when the full-protection eyewear may completely block the beam. Alignment eyewear will NOT stop a full-power direct beam.

Full-protection eyewear is designed to reduce exposure to a level safely below Maximum Permissible Exposure (MPE).

How Laser Eyewear Works

- filter lowers beam intensity to *Maximum Permissible Exposure (MPE)*
- below MPE = SAFE
- above MPE = NOT SAFE



tinted safety glasses



laser protective eyewear

Audio Narration (slide 4)

Here is a pair of tinted safety glasses. As you can see, the beam passes directly through the lens. Here is a pair of laser protective eyewear. The beam does not penetrate the lens and thus protects your eyes. Laser eyewear is a filter designed to lower the intensity of the incident laser beam, either by reflection or absorption, to a safe level no higher than the Maximum Permissible Exposure, or MPE. Exposure below MPE will not cause an eye injury. Think of MPE as the speed limit. The higher you go above the limit, the greater your risk of having an accident and the greater the consequences of injury.

Vital Elements in Eyewear Selection

- fit
- *optical density (OD)*
- *visible light transmission (VLT)*
- prescriptions
- sensor card use
- field of vision



Audio Narration (slide 5)

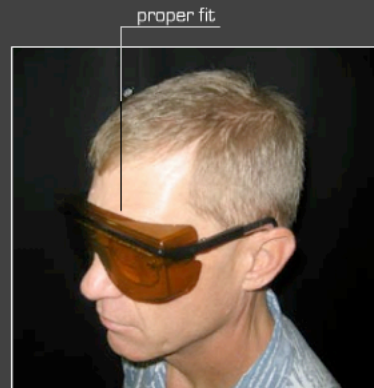
To be effective, laser eyewear must be chosen for the specific work environment involved. The key factors to consider in selecting laser eyewear are:

- Fit
- Optical Density, or OD
- Visible Light Transmission, or VLT
- Prescriptions
- Sensor card use
- Field of vision

Fit

Comfort and proper coverage issues:

- clumsy or uncomfortable
- weight
 - multi-wavelength
 - prescription



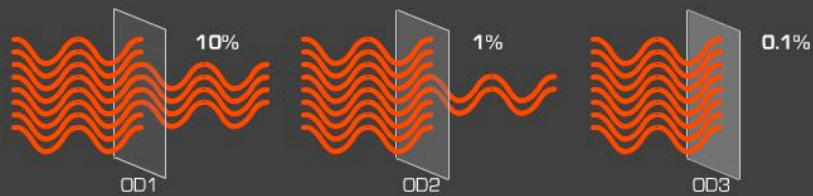
Audio Narration (slide 6)

Eyewear must fit properly. Both comfort and proper coverage must be considered. If your laser eyewear is clumsy, heavy, or just plain uncomfortable, you probably won't wear it. Don't find reasons not to wear eye protection. Your eyes are two great reasons why to wear it.

Weight is a particular concern when multi-wavelength or prescription eyewear is needed. Breakthroughs in polycarbonate eyewear, in the form of flips and over-glasses, may help lessen this burden. Contact your laser safety officer to help you find the right PPE for the job.

Optical Density [OD]

Optical Density	% Radiation Transmission
1	10%
2	1%
3	0.1%
4	0.01%
5	0.001%
6	0.0001%
7	0.00001%

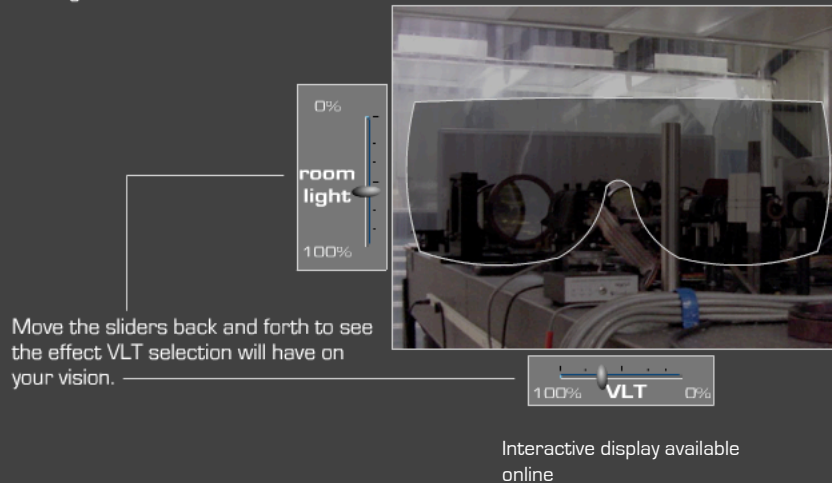


Audio Narration (slide 7)

OD is calculated in base 10. That is, as OD increases, the protection against laser radiation increases by a factor of ten. OD 1 filters allow 10% transmission of the laser radiation. OD 2 allows 1%, OD 3 allows 0.1%, and so on.

Visible Light Transmission [VLT]

- the higher the VLT, the easier it is to see.
- below 20% = very dark.
- low light + low VLT = darkness.




Audio Narration (slide 8)

Visible Light Transmission, or VLT, is another important selection factor with laser eyewear. The higher the VLT, the easier it is to see through the eyewear. VLTs below 20% are very dark, as seen here. Working in a low-light environment with low-VLT eyewear is like working in the dark - which can present its own unique safety hazards, such as tripping.

Prescription Eyewear

Options:

- ground prescriptions
- inserts
- flips
- over glasses



Talk to your supervisor about the availability of prescription eyewear.

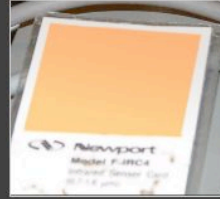
Audio Narration (slide 9)

As mentioned earlier, prescriptions can play a role in the comfort and usability of your safety eyewear. If you wear prescription glasses, you have several options. You can have your prescription ground into the lens of your eyewear, use eyewear that holds prescription inserts, or use eyewear with flips. For ground lenses, frame selections now include titanium frames with adjustable temples. Also, some goggles will fit directly over your prescription glasses.

Talk to your supervisor about the availability of prescription eyewear.

Sensor Card Use

- eyewear must allow you to see the fluorescence or glow.



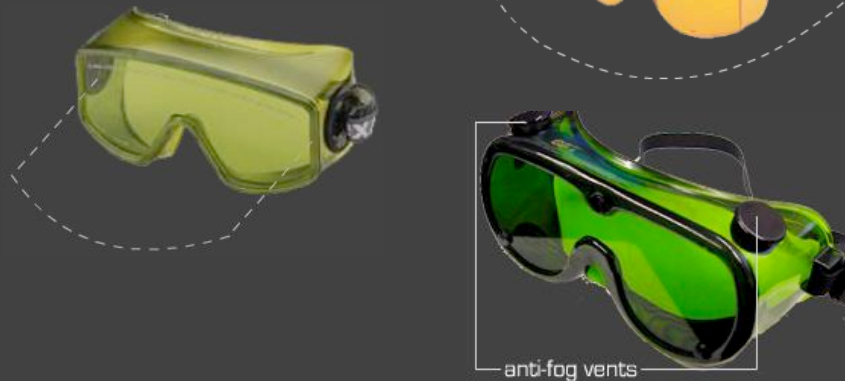
Audio Narration (slide 10)

Again, sensor cards are most commonly used to locate UV or infrared beams. The beams strike the card and produce visible fluorescence. Therefore, the protective eyewear you use must allow you to see that fluorescence or glow.

Other Laser Protective Eyewear Considerations

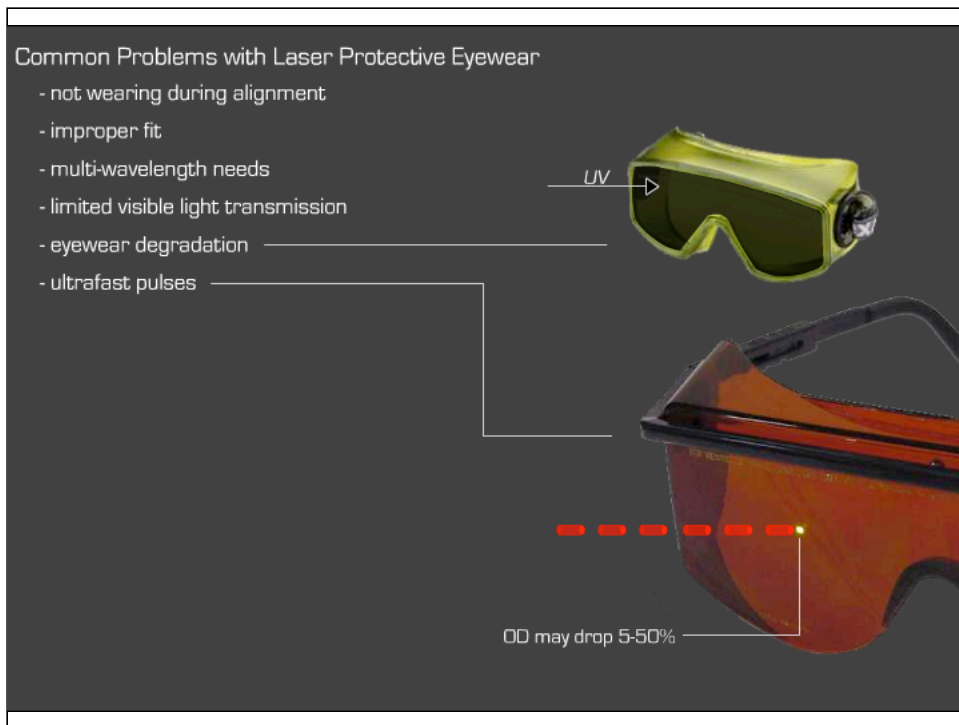
Field of vision:

- peripheral vision
- anti-fog capability



Audio Narration (slide 11)

Another important consideration when choosing laser safety eyewear is your field of vision. Being able to see in a safe manner is of obvious importance. Look for eyewear that provides good peripheral vision and anti-fog capabilities. Pictured here is a pair of glasses with clear protective side shields which provides good peripheral vision. These goggles limit peripheral vision. Anti-fog eyewear will have vents or special coating, and will be noted as such on the eyewear by the manufacturer.



Audio Narration (slide 12)

Again, the primary problem with laser eyewear is that too often people don't use it while aligning laser beams. Other problems that we've discussed include:

- Improper fit
- Finding eyewear that meets multi-wavelength needs.
- And, limited Visible Light Transmission.

Eyewear degradation (that is, aging or bleaching) may occur after prolonged exposure to ultraviolet wavelengths. The absorptive material is depleted to the point where the eyewear gets darker or the optical density is affected.

Also, studies have shown that a series of pulses can be too fast for the eyewear to absorb. Exposure by an ultrafast series of pulses to a spot can cause the optical density at that spot to drop from 5 to 50%. So, again, always be aware of your surroundings. Don't think your eyewear is a magic force-field. Eyewear has limitations.

Eyewear Storage

Proper storage will:

- extend the life.
- reduce scratches.
- keep them from getting lost.



Audio Narration (slide 13)

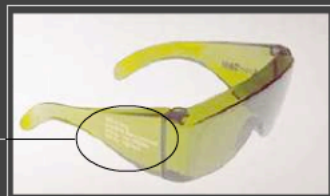
Store your eyewear in a clean, dry place. Proper storage will:

- Extend its life.
- Reduce scratches.
- Keep the eyewear from getting lost.

Eyewear Labeling

ANSI Z136.1 standard

- wavelength range
- OD at those wavelengths



FOR VIEWING OF DIFFUSE LASER LIGHT ONLY

O.D. 7 @ 190 - 532 nm
O.D. 5+ @ 800 - 839 nm
O.D. 7+ @ 865 - 1063 nm
O.D. 7+ @ 1064 nm
O.D. 5 @ 10600 nm

O.D. > 6.5 @ 1053 - 1064 nm
O.D. > 5 @ 800 - 839 nm
O.D. N/A @ 400 - 700 nm

Audio Narration (slide 14)

All laser safety eyewear must meet the ANSI Z136.1 standard. Thus, at a minimum, all eyewear will be marked with the wavelength range and optical density for those wavelengths. Read the laser warning signs or illuminated warning signs for wavelengths being used in a given laboratory. Check to see that the eyewear you have selected matches the postings. Educated people have picked up the wrong pair before. Don't become a statistic.

Custom Eyewear Labeling

- Laser users will sometimes custom label laser protective eyewear.
- documentation must be readily available.



Nd:YAG & GaAs
5 μm - 11 μm O.D. > 7
0.86 - 1.08 O.D. > 7
0.75 - 0.86 O.D. > 5
0.71 - 0.75 O.D. > 3
0.69 - 0.42 O.D. > 9

Audio Narration (slide 15)

Due to the extensive range of wavelengths, laser users will sometimes custom label laser protective eyewear. In such cases, the wavelength and OD documentation must be readily available. If there is no label on your eyewear, ask for the documentation to verify that that eyewear is appropriate for the wavelength in use. Don't assume the eyewear is appropriate. Make sure your eyewear matches the wavelength you are using.

PPE Quiz

Pretests and end-of-module quizzes are only available online. This quiz must be successfully completed. To do so, access the online course and go to the menu. Here, select module 8 and then advance through the slides until you reach the last slide (the quiz).